Addressing Deep Vadose Zone Cleanup at Hanford

Deep Vadose Zone Applied Field Research Center

The DOE-EM Office of Technology Innovation and Development is initiating the Deep Vadose Zone Applied Field Research Center at the Hanford Site. The Center provides the framework for a coordinated and integrated research and technology development strategy for the deep vadose zone. The Center leverages field investigations and treatability testing done by the site contractors and advances research from the DOE Office of Science's Scientific Focus Areas. One of the Scientific Focus Areas, located at PNNL, deals with subsurface controls on reactive transport of contaminants. This work, combined with the Applied Field Research Center, will enhance the fundamental understanding of the deep vadose zone problem and infuse investments from DOE-EM and DOE-RL to develop (1) more cost effective characterization and monitoring methods and (2) remedial strategies that use a combination of surface infiltration measures, long-term monitoring of deep vadose zone contaminant plumes, and treatment and extraction of contamination.

200-DV-1 Operable Unit

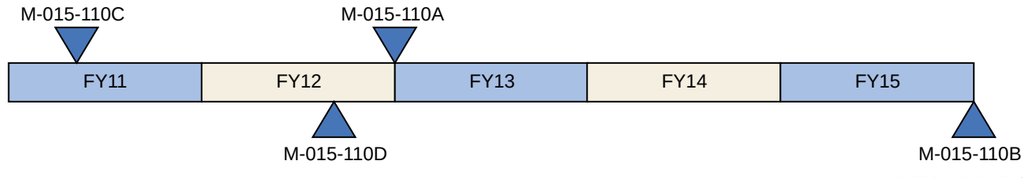
Creation of the 200-DV-1 (deep vadose zone) Operable Unit (OU) brings a centralized focus and systematic approach to the challenges presented by contamination in the deep vadose zone. This operable unit includes the sites that require specialized remediation approaches and cannot be remediated using typical surface-based techniques. The decision process for the 200-DV-1 Operable Unit will investigate the nature and extent of deep vadose zone contamination; evaluate potential impacts on groundwater; and evaluate, select, and implement management strategies for addressing deep vadose zone threats to the environment.

This approach will help mitigate the potential threat of release and, at the same time, provide early warning of significant contaminant movement or impacts to groundwater as part of the long-term monitoring and institutional controls.

New TPA Milestones Adopted for the Deep Vadose Zone

- **M-015-110A**, submit Resource Conservation and Recovery Act (RCRA) Facility Investigation/Corrective Measures Study & Remedial Investigation/Feasibility Study work plan for the 200-DV-1 OU to Ecology. The work plan shall include technology screening that identifies technologies applicable for characterization, treatment, and monitoring of deep vadose zone contaminants. Due date: 9/30/2012.
- **M-015-110B**, submit Corrective Measures Study & Feasibility Study Report and Proposed Plan/Proposed Corrective Action Decision for the 200-DV-1 OU to Ecology. Due date: 9/30/2015.
- **M-015-110C**, submit uranium treatment technology field test plan as an element of the RCRA facility investigation and remedial investigation for the 200-DV-1 OU to Ecology. Due date: 12/31/2010.
- **M-015-110D**, submit technetium-99 pilot scale treatability study test report(s) as an element of remedial investigation for the 200-BC-1/200-WA-1 OUs to EPA. Due date: 6/30/2012.

Deep Vadose Zone Milestones



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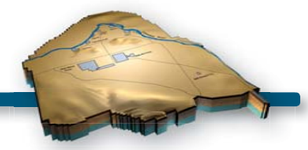
Hanford Site - Deep Vadose Zone Cleanup Challenge



The U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) – the Tri-Party Agreement (TPA) agencies – are addressing the challenges of cleaning up the deeper contamination on the Central Plateau at the Hanford Site in southeast Washington State by initiating the Deep Vadose Zone Project. The project is addressing the challenge by instituting:

- An Applied Field Research Center to develop innovative remediation alternatives for deep vadose zone challenges in characterization, prediction, remediation, and monitoring; and
- A separate operable unit (200-DV-1) to focus on arriving at a cleanup decision for the deep vadose zone.

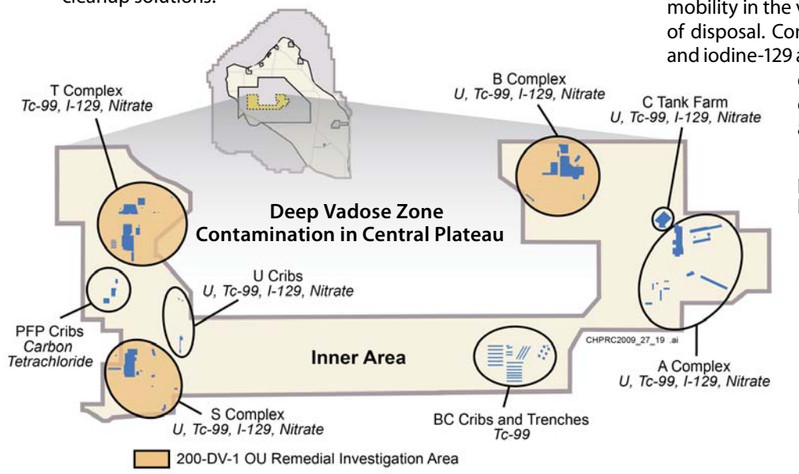
The TPA agencies established the Project in response to input from the Tribal Nations, the State of Oregon, the Hanford Advisory Board, and stakeholders to place greater focus on deep vadose zone cleanup.

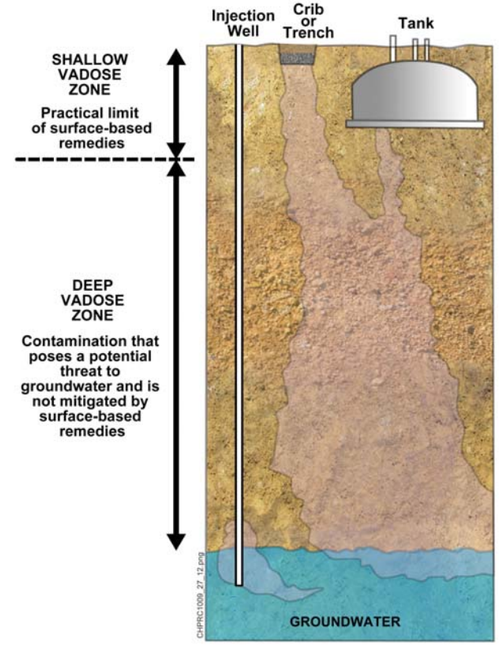
Deep Vadose Zone Project

The Deep Vadose Zone Project leverages DOE's investments in basic science, applied research, and Hanford Site remediation to identify solutions for characterizing, remediating, and monitoring the deep vadose zone sediments overlying the groundwater. The project is a collaborative effort among DOE [DOE-Environmental Management (EM), DOE-Richland Operations Office, and DOE-Office of River Protection], Pacific Northwest National Laboratory (PNNL), and Hanford Site contractors (CH2M HILL Plateau Remediation Company and Washington River Protection Solutions).

The ultimate goal of the Deep Vadose Zone Project is to ensure long-term protection of groundwater on the Central Plateau. Key components of the strategy for obtaining this goal are:

- Increasing DOE investment in treatability testing of initial candidate technologies;
- Increasing DOE investment in evaluating innovative approaches to characterize, remediate, and monitor the deep vadoze zone; and
- Facilitating the transition of scientific research results to applied cleanup solutions.





Background

The vadose zone, which on average is 250 feet thick, was contaminated during operations when liquid wastes were intentionally disposed of in engineered infiltration facilities such as cribs and trenches and unintentionally released from liquid waste tanks. Released contaminants that have limited mobility in the vadose zone remain relatively close to the site of disposal. Contaminants such as technetium-99, uranium, and iodine-129 are more mobile and have migrated to regions deep within the vadose zone, reaching the groundwater in some locations and posing a long-term threat to groundwater in others.

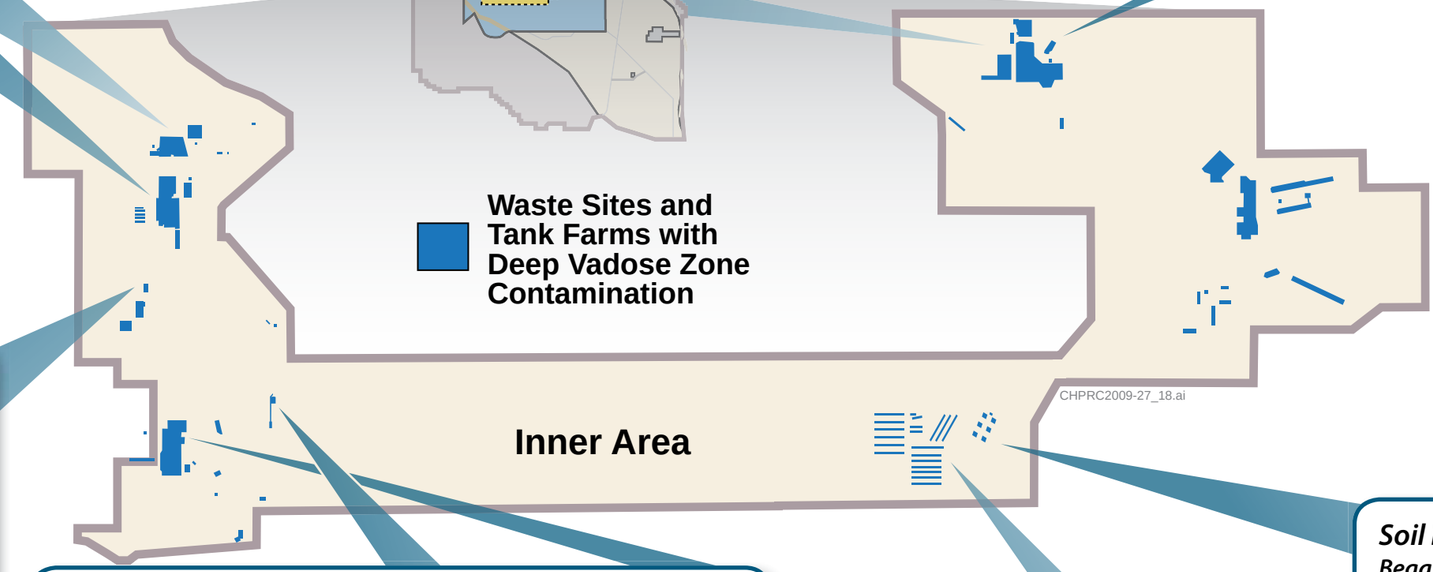
Cleanup of the contamination in the deeper portion of the vadose zone is challenging because:

- Conventional, surface-based remedies have limited effectiveness;
- The contamination is difficult and expensive to access;
- Different contaminants occur in different hydrogeological settings; and
- Remedy performance is difficult to predict, test, and monitor.

U.S. DEPARTMENT OF ENERGY
CH2MHILL Plateau Remediation Company

Deep Vadose Zone Field Activities

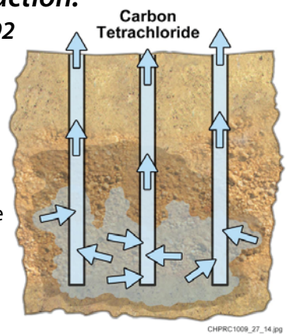
The following technologies are either on-going as interim remedial actions or being field-tested at deep vadose zone sites on the Central Plateau:



Surface Barrier Tests:
Began 2008

The intent of this technology is to stop water from moving into the vadose zone, where it could drive mobile contaminants down toward groundwater.

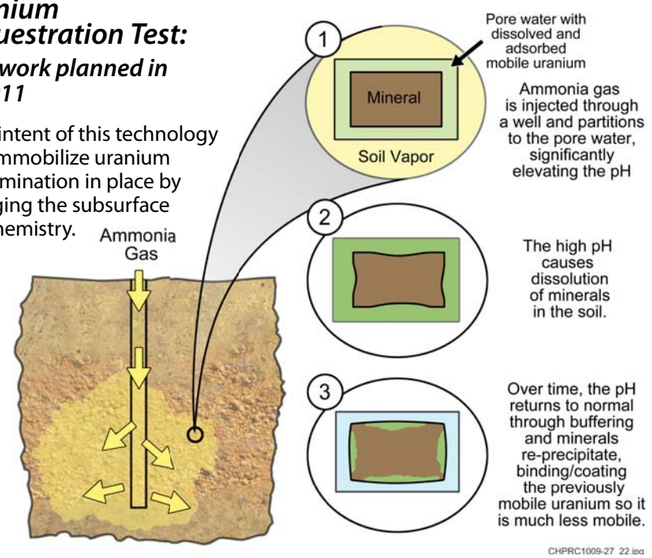
Soil Vapor Extraction:
Ongoing since 1992



The intent of this technology is to remove soil gas containing carbon tetrachloride. The soil gas is extracted from the vadose zone through multiple wells. Soil vapor extraction is being used as an interim remedial action. The carbon tetrachloride contamination in the vadose zone has been significantly reduced through application of soil vapor extraction. A treatability test is planned to characterize the nature and extent of the remaining contamination.

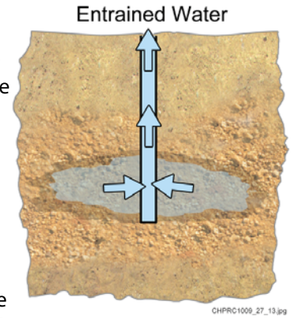
Uranium Sequestration Test:
Fieldwork planned in FY2011

The intent of this technology is to immobilize uranium contamination in place by changing the subsurface geochemistry.



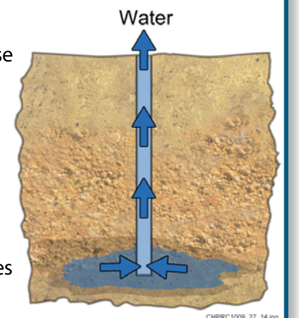
Pore Water Extraction Test:
Fieldwork planned in FY2011

The intent of this technology is to extract subsurface water containing mobile contaminants. Soil gas with entrained water droplets is extracted from the subsurface through a well using a high vacuum to induce high air flow rates (~ 500 ft^3/min).



Perched Water Removal:
Fieldwork planned in FY2011

The intent of this technology is to remove contaminated perched water from the vadose zone before it migrates to groundwater. The perched water is pumped from the subsurface through a well at low flow rates (~1 gal/min).



Soil Desiccation Test:
Began November 2010

The intent of this technology is to dry the vadose zone soil to remove the driving force for downward migration of contaminants. Dry air (nitrogen gas) is injected into the subsurface through one well, and humid air is extracted from the subsurface through another well.